Educational Sciences: Theory & Practice - 13(2) • Spring • 1235-1250

www.edam.com.tr/estp

# Design and Development of a Sample "Computer Programming" Course Tool via Story-Based E-learning Approach*

**Utku KOSE**[a]
Usak University

**Durmus KOC**[b]
Usak University

**Suleyman Anil YUCESOY**[c]
Usak University

**Abstract**

This study introduces a story-based e-learning oriented course tool that was designed and developed for using within "computer programming" courses. With this tool, students can easily adapt themselves to the subjects in the context of computer programming principles, thanks to the story-based, interactive processes. By using visually improved elements, it is aimed to ensure a step-by-step learning – teaching session, which allows students to organize a typical learning process on their own. As a result of using this approach and the story-based environment, it can be very easy, fast and entertaining for students to learn fundamentals of the computer programming approach and its related sub-subjects. Furthermore, complex, technical and abstract concepts of a typical computer programming course can also be taught easily without needing for any extra material to improve course conditions.

**Key Words**

E-learning, Story-based e-learning, Interactivity, Human-Computer Interaction, Computer Programming.

Within the education field, technology based approaches, methods or techniques have an important role on ensuring more effective and efficient learning – teaching experiences for both students and teachers. In this sense, especially distance education based techniques like e-learning provide many different advantages and innovations to improve the current standards of the education field and the related studies associated with this field (Garrison,

* This paper was revised after being presented at 6th International Computer and Instructional Technologies Symposium, Gaziantep, Turkey, 4-6 October 2012.

**a** **Utku KOSE** is currently a lecturer at Directorate of Computer Center and also Computer Technologies Dept. of Karahalli Vocational School. Her research interests include artificial intelligence, the chaos theory, distance education, e-learning, computer education, and computer programming approaches. Correspondence: Lect. Utku KOSE, Usak University, 1 September Campus, Directorate of Computer Center, Usak, Turkey. E-mail: utku.kose@usak.edu.tr Phone: +90 532 590 8326.

**b** Durmus KOC is currently a lecturer at Computer Technologies Dept. of Karahalli Vocational School. Contact: Lect. Durmus KOC, Usak University, Karahalli Vocational School, Karahalli, Usak, Turkey. E-mail: durmus.koc@usak.edu.tr

**c** Suleyman Anil YUCESOY is currently a lecturer at Electronics Technology Dept. of Usak Vocational School. Contact: Lect. Suleyman Anil YUCESOY, Usak University, 1 September Campus, Usak Vocational School, Usak, Turkey. E-mail: anil.yucesoy@usak.edu.tr

2011; Georgios, Denise-Penelope, Angelos, & Stefanos, 2007; McCormack & Jones, 1997). However; as a result of rapid improvements on the technology and humankind's related life standards, there have always been need for more innovations for even the latest developments in the context of the education field. As being more specific, there is also need for more innovations for the e-learning and its related studies in order to improve the current advantages of the related technique (Garrison; Lin, Ho, & Hsieh, 2013; Robson, 2013).

Nowadays, it is a remarkable subject for designing and developing interactive e-learning tools for enabling students to take active part in an effective e-learning process and learn the related course lectures in a more efficient and faster way. At this point, using animations, colorful interfaces or providing similar, attractive features are not being enough to ensure the related interaction between the computer and the student; so more research studies on the related subject are performed from different perspectives (Garrison & Kanuka, 2004; Lau, Yen, Li, & Wah, 2013). In this sense, story-based e-learning approach is an effective approach to ensure the necessary interaction level with the support of virtual stories. It is important that story-based e-learning tools enable students to perform learn-by-doing sessions in the context of experiences provided by the events of designed stories.

The story-based e-learning tools can provide effective and efficient ways – approaches for solving the related problems in the context of especially teaching – learning processes. At this point, one of the most important problems encountered within the education field is providing effective enough approaches for enabling students to understand and learn the related subjects provided in complex, technical courses. On the other hand, teachers can also need more advanced and effective ways for teaching such courses and ensuring more successful teaching processes. Because of this, such interactive, technology supported approaches like using story-based e-learning tools provide many advantages on improving the teaching – learning processes.

Associated with the related explanations, this study aims providing a viewpoint to the story-based e-learning approach by designing and developing a tool for "computer programming" course. By using this tool, students can easily adapt themselves to the subjects in the context of computer programming principles, thanks to the story-based, interactive processes. With visually improved elements, it is aimed to ensure a step-by-step learning – teaching session, which allows students to organize a typical learning process on their own. As a result of using this approach and the story-based environment, it can be very easy, fast and entertaining for students to learn fundamentals of the computer programming approach and its related sub-subjects. Additionally, complex, technical and abstract concepts of a typical computer programming course can also be taught easily by teachers without needing for any extra material to improve course conditions. Eventually, the story-based e-learning tool, which is introduced in this study, ensures an effective approach to learn – teach fundamentals of the computer programming approach, which is an essential subject for especially computer and information technologies oriented academic fields.

Definitely, there are many different kinds of tools within the literature in order to provide effective and efficient enough approaches for providing alternative approaches – applications for the educational processes within especially complex, technical courses (Alario-Hoyos et al., 2013; Buckley & Quellmalz, 2013; Caballe et al., 2013; Gilbert, Wang, & Sim, 2005; Kose & Deperlioglu, 2012; Ovalle, Arias, & Moreno, 2013; Pulman, Scammell, & Martin, 2009; Toral, Barrero, Martínez-Torres, & Gallardo, 2007). In this sense, it is an important approach to evaluate such tools in terms of achieving the educational objectives. Because; students, who are in the center of the related learning processes, are important actors for determining the success of a teaching – learning tool and their ideas and feedbacks can give remarkable findings to researchers for validating the success of an educational tool or application.

The rest of the paper related to the whole scientific approaches and the associated study is organized as follows: In the second section, the main problem statement of the study is explained briefly. Right after, the method – solution approach is introduced in the third section. In this section, the main solution approach and associated techniques are expressed in order to give more idea about directions of the study for solving the main problem statement. After the third section, the designed and developed tool is explained in the fourth section. In this sense, design principles and pedagogical aspects of the tool and also its using features and functions are explained briefly. Following the fourth section, application – evaluation processes performed for understanding effectiveness and success of the tool and the related

findings obtained via these processes are provided within the fifth section. Finally, results of the performed study and also some future works related to next research stages are discussed in the last section.

### Problem Statement

As it was mentioned before, this study is related to some kind of course tool that was designed and developed for using within computer programming courses. In this sense, the problem of the study is basically based on "difficulties in teaching computer programming". Within this concept, the related explanations associated with the main problem statement are expressed as below:

Students learning the computer programming approach for the first time can find it too much difficult to understand the "algorithmic thinking" and "principles of computer programming". Computer programming approach is connected with many abstract and theoretical subjects needing more advanced studies to be understood and also learned. Especially in programming language oriented courses, students often find it difficult to use their knowledge for designing and developing different types of computer programs that are related to solving specific problems. Additionally, another important factor that triggers the mentioned problem is also complexity of today's programming languages. When computing was first introduced and performed mechanically, programming vocabulary consisted of the sequencing of basic steps. But the subsequent addition of procedural abstraction and some innovations like object orientation allowed more abstract conceptualization of computing (Connolly, Murphy, & Moore, 2009). Eventually, more advanced and complex programming techniques and languages have been designed and developed.

Nowadays, educational institutes like universities provide the latest course contents about computer programming. Hereby, courses cause some students to become anxious, or even to fear computer programming approach. Because the general performance is negatively affected by the anxiety, the impact on academic performance has also negative effects on retention rates. Furthermore, uncontrolled anxiety levels affect students' ability and cause poor academic progress associated with high dropout rates (Acelajado, 2003).

Because of the expressed statements, there is a remarkable and important need on employing more effective and efficient approaches, methods or techniques for learning – teaching computer programming approach. In this context, many different scientific studies and efforts are performed by researchers and scientists to solve the main problem of learning – teaching computer programming. Actually, this effort can also be associated with providing more effective and efficient educational approaches for removing difficulties on learning – teaching especially abstract and complex subjects that take part in technical and applied courses. In other words, a research effort on providing effective and efficient approaches, methods or techniques for learning – teaching computer programming can also bring about newer approaches or visions for learning – teaching technical and applied courses, which is also another research interest and problem of the education field.

### Method – Solution Approach

The method – solution approach provided within this study is based on combining two educational approaches together to obtain an effective, versatile work for improving learning – teaching experiences. In this context, story-based learning and e-learning are employed to design and develop a sample computer programming course tool inspired from the idea of a typical story-based e-learning environment. At this point, the related approaches must be explained briefly in order to have more idea about the solution approach.

### Story-based Learning

Story-based learning is some kind of learning approach based on employing the attractive and effective ways of stories on learning processes of a person. At this point, stories are evaluated as an integral part of people's lives and also it is thought that they are fundamental to "human communication and learning" (Joseph, 2012; Kadle, 2010). According to Kadle, they have also been an important trace in people's lives in the form of "fables", "bedtime stories", "gripping novels" to "films" and also "animations". It is also known that stories also provide an episodic structure shaping people's experiences (Lee, Mott, & Lester, 2010).

In the context of the education field, the attractive and effective aspects of stories have also been used to create an alternative way to improve educational experiences. Because of their positive effects on imagination and creativity and also connec-

tion with several linguistic aspects, stories have been evaluated as unique, supportive elements to improve educational processes. In this context, especially rapid developments in the technology have also given rise to remarkable research efforts on designing and developing newer story-based learning methods and as a result, interactive, visually and auditory improved story-based learning environments have been introduced, thanks to the especially multimedia and computer – software technology.

Nowadays, the form of story-based learning in electronic platforms have caused introducing a new concept explaining the connection of learning aspects of stories with the educational functions of electronic devices like computers. Thus, "story-based e-learning" approach has been appeared within the related literature. At this point, a brief explanation of the e-learning approach must also be provided to enable readers to have better idea about the general solution approach.

**E-learning**

Briefly, the e-learning approach is a typical distance education-based technique allowing people to remove limitations of time and place by using electronic devices. At this point, computer technology and the related systems have an important role on popularity of today's e-learning oriented applications.

In more detail, e-learning allows teachers to provide educational materials and the related knowledge to a wide-range of students by using more effective and efficient communication channels. In a typical e-learning process, it is not necessary for students to attend classrooms to follow face-to-face sessions of the given courses. In this sense, they are enabled to take part in special course sessions and establish contact with other students or teachers by using some advanced tools. These educational activities are performed via conventional or modern communication infrastructure (Garrison, 2011; Georgios et al., 2007).

As it was mentioned before, the technological aspect of the computer systems have given rise to form an e-learning approach based on the act of taking stories into an interactive, virtual environment.

**Story-based E-learning**

Story-based e-learning is the form of a virtually designed story flow enabling people to take part in a visually and auditory improved story environment in which they are also allowed to experience an interactive learning process (Gjedde, 2006). At this point, interactivity level has been improved via especially computer-based elements in order


**Figure 1.**
*Some Screenshots from Several Story-Based E-Learning Applications (Kadle, 2010; Wisdom Tools, 2009).*

to improve number of senses to perform effective understanding and learning behaviors. As it can be understood, today's popular trend is designing and developing story-based e-learning applications or systems provided on computer systems. In this way, the power of computer-based software and hardware solutions allow researchers, designers and developers to perform collaborative work to create unique e-learning environments aiming to improve the related educational experiences. Figure 1 represents some screenshots from several story-based e-learning applications (Kadle, 2010; Wisdom Tools, 2009).

Because of providing interactivity and more effective approaches on affecting multi-senses, the story-based e-learning approach can also be employed to ensure a sample educational material to support learning – teaching especially technical and applied courses including abstract, complex subjects. In this sense, it is also possible to design and develop a sample story-based e-learning tool for a typical computer programming course.

**Validation of the Method – Solution Approach**

Developing a story-based e-learning tool for a typical computer programming course can provide many advantages on improving the related teaching – learning processes. Because of this, it can be evaluated as an alternative, effective approach for achieving the related objectives of this study. However; as it was also mentioned in the context of the Introduction section, design and development of such an educational tool does not guarantee effective and efficient educational process. In order to validate – prove the success of such tool, some evaluation – test processes regarding to students must be done via typical approaches. In this sense, some approaches like "experimental application" and "student survey", which can be applied shortly after an experimental application, can be performed in the context of such research study.

**A Sample Computer Programming Course Tool via Story-Based E-Learning Approach**

The educational tool designed and developed in this study aims to ensure an effective and efficient e-learning platform for learning – teaching the computer programming approach via explained solution approach: story-based e-learning. At this point, it is important that the related tool comes with visually and auditory improved elements trying to affect students on more than one sense. In this sense, targeting multi-sense during the educational process is an important and remarkable function to success the general educational objectives. Because of this, especially visual aspects – interfaces of the tool have been designed and created meticulously. In addition, sounds used within the tool has also been created or chosen carefully to form the whole story-based e-learning platform. On the other hand, the tool has also been developed according to a "story flow – scenario", which was written before to obtain a simple but effective enough learning – teaching process in which students can take an active part to follow the story and understand and learn computer programming approach and the related subjects in this way.

In order to understand the performed study and learn more about the course tool, design principles and pedagogical aspects of the tool and also its using features and functions must be explained briefly. These aspects of the computer programming course tool are explained as below; under the related titles:

**Design Principles of the Tool**

Briefly, design principles of the course tool can be examined in the context of design aspects to provide an effective educational material that can be used by students. In more detail, these principles are based on some theoretical and imaginary ideas and they were also transformed into the real life from imagination, by using some computer programs. Before introducing the related computer programs, it is important to talk about the related design principles of the tool. The main design principles of the designed and developed tool are expressed as below:

- Within the tool, appropriate colors were used for ensuring visually improved, simple interfaces. At this point, only necessary and easy-on-eyes colors are used to provide comfortable using experiences.
- For ensuring an easy-to-use e-learning environment, some typical, visual controls were located on the related interfaces of the tool. In this way, using experiences are improved effectively.
- Within interfaces of the tool, lots of semaphores were employed to direct students easily

in the story flow – scenario and allow them to experience a fast learning process.

- In addition to the teacher assisted processes, some tool functions were also included in the tool in order to enable students to perform their own learning processes. At this point, some effective functions like saving or loading scenario sessions or adjusting tool options are included within the tool software system.
- In the tool, lots of directive and / or supportive visually or auditory developed elements were also employed to improve students' using experiences.

In order to achieve the mentioned design principles in the context of a typical e-learning software system, some computer programs were employed during the design and development processes of the tool. The related programs and their roles during the creation of the tool are explained briefly in the following paragraphs:

- Adobe Illustrator CS 4 and Adobe Flash CS 4 were used for designing visual interfaces and the related elements – objects of the tool. At this point, vector-based design aspects of the related programs allowed creating detailed visual images.
- Adobe Flash CS 4 was also used for creating animations employed within the course tool. In this sense, Visual elements – objects created via Adobe Illustrator or Adobe Flash environment were taken into the animation process, thanks to the Action Script interface of the Adobe Flash CS 4.
- In order to support educational knowledge-base and programmatic infrastructure of the tool, SQL Server 2008 R2 was employed to design and develop a database interface. This database interface stores the whole programmatically adjustable and applicable functions of the tool and also educational materials (dynamic questions, quizzes…etc.) that are used via tool, during the learning – teaching processes.

**Pedagogical Aspects of the Tool**

As it can be understood from the study subject and the related explanations, the main function of the tool is based on providing a scenario-based e-learning approach enabling teachers and students to take active part in an interactive, story-based environment. At this point, the course tool employs the whole pedagogical aspects of the related approaches, methods or techniques like e-learning and story-based learning. Additionally, it is also possible to some specific pedagogical aspects to give more information about effectiveness of the designed and developed tool on learning – teaching the computer programming. The foremost pedagogical aspects of the tool are explained briefly as below:

- The tool includes a typical story – scenario flow aiming to provide a step-by-step learning – teaching session. In this way, students are enabled to start the computer programming course from basics of algorithms and flow charts and continue to next stages by making additions to the previously learned subjects. They are also allowed to organize their own learning process by using the provided control within the tool. At this point, it is possible to examine the general story – scenario flow of the tool in order to understand the related approach. Figure 2 represents a schema explaining the story – scenario flow briefly.

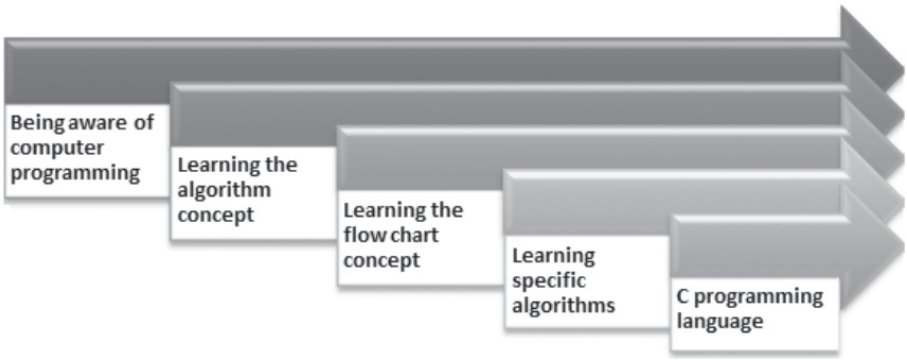


**Figure 2.**
*The Story – Scenario Flow within the Computer Programming Course Tool*

- Another pedagogical aspect in the sense of the tool is "feedback". Feedback factor is used in the tool in order to ensure effective interaction between students and the provided story. In the literature, feedback factor is regarded as one of the most critical sources of information to assist students in restructuring their own knowledge and support their metacognitive processes (Clark & Dwyer, 1998; Foote, 1999; Sales, 1993). Today, the feedback factor is widely used in many educational activities to provide more effective learning processes for students. Feedback is especially necessary for courses, which are based on technical and applied subjects. It is clear that students can learn abstract and complex concepts and perform applied exercises better when they receive immediate feedbacks. Otherwise, both teachers and students encounter many difficulties during learning – teaching processes.

  In the course tool, some feedback approaches directing students during the story – scenario flow are used in order to ensure the related interactivity and flow. In this context, especially exercise oriented answers or actions by the student are responded with feedbacks like "correct answer – action" or "incorrect answer – action". At this point, the related feedback approaches are examined under the "knowledge of response" within the literature (Dempsey, Driscoll, & Swindell, 1993).

- The course tool also allows students to create their own character on the related environment and take part in the story flow by controlling the created – personal character. In this way, the tool and the related e-learning environment become more attractive and entertaining for especially students. Furthermore, creating their own character and using it for making decisions and performing the story-based activities on the virtual environment enable students to improve their self-confidence and self-efficacy. Briefly, students are also improved psychological while they are learning computer programming approach and the related subjects.

- The course tool is supported with many different exercises and quizzes allowing students to understand and learn the related computer programming subjects via "learn-by-doing" approach. At this point, it is remarkable that the explained feedback factor has an active and effective role on providing necessary directive functions to enable students for performing exercises, taking part in quizzes and obtaining the related knowledge and abilities about computer programming approach. Additionally, it is also important that the mentioned exercises and quizzes are blended with the story – scenario flow oriented actions performed within the virtual environment. In this way, the tool provides an entertaining and dynamic learning – teaching platform rather than ensuring a typical, mostly boring educational software platform.

**Using Features and Functions**

The course tool comes with many different using features and functions aiming to provide an interactive, visually and auditory improved e-learning platform. In this context, the tool also provides an entertaining environment enabling students to perform their learning process in a colorful, attractive educational material supported with the computer – software technology. During the design and development processes, it was aimed to include easy, fast and effective using features and functions within the tool. In this sense, explained design principles and pedagogical aspects were taken into account to form the related software system-based tool.

Generally, the tool can be run on an average-level configured computer system. It is also possible to run the tool on different kinds of operating systems like Windows, Linux and MacOS. At this point, it is also important that the additional software: "Adobe Flash Player" must also be installed on the related operating system. On the other hand, in order to make use of the tool at the desired effectiveness level, multimedia features (like video, sound interfaces) of the computer system must also be enabled. This is an important point to achieve the related educational objectives via a story-based e-learning software system.

In order to understand the usage of the tool, it is important to talk about general using features and functions. In this context, the foremost points about using features and functions of the tool are explained briefly in the following paragraphs:

- As it was mentioned before, the tool is based on the story – scenario flow explained within the Figure 2. At this point, the related story – scenario flow has been integrated into the software system by using "designed scenes" in order to ensure a typical learning process. At this point, the original story – scenario flow have also been supported with some additional scenes includ-

**Table 1.**
*The Story – Scenario Flow Associated with the Scenes*

| Story – Scenario Flow (Scope) | Associated Scenes |
|---|---|
| "Being aware of computer programming" | starting scene |
| "Learning the algorithm concept" | scene *1, 2, 3* |
| "Learning the flow chart concept" | scene *4, 5, 6, 7* |
| "Examples combining algorithm and flow chart" | scene *8* |
| "Basics of algorithms and flow charts" | scene *9, 10, 11, 12, 13, 14, 15* |
| "Exercises and quizzes" | scene *16, 17, 18, 19, 20* |
| "Learning specific algorithms" | scene *21, 22, 23, 24, 25* |
| (The story continues with the C programming language) | scene *26, … 72* |
| "Exercises and quizzes" | scene *73, 74, 75, 76, 77, 78* |

ing exercises, examples or quizzes related to the course of computer programming. Briefly, the course tool includes a total of 78 scenes. In this context, the story – scenario flow associated with the scenes – software system can also be analyzed in detail as represented in table 1.

- As it can be understood, the related flows – actions within the provided story – scenario must be done via some kind of interactive controls that can be located on the interfaces of the course tool. At this point, it is possible to use mouse control and perform the related actions by clicking on interactive elements – objects appeared on scenes of the tool. In this sense, students are directed via some virtual, dynamic messages viewed on the related scenes. Previously explained feedback factor is also included within this "virtual, dynamic message feature". Furthermore, messages are also viewed by using specific shapes and colors supporting the semaphore-based approach of the course tool. Related to the virtual, dynamic message feature (as general; messaging function), Figure 3 shows the related message elements – objects and their meanings within the course tool.


**Figure 3.**
*Message Elements – Objects and their Meanings within the Course Tool*

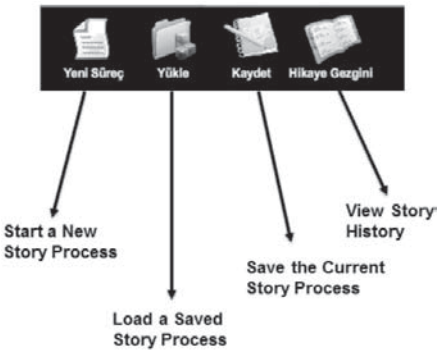


**Figure 4.**
*Tool Bar of the Course Tool and the related Controls Provided*

- In addition to the provided messages, a simple, virtual "tool bar" is also located on the tool interfaces. By using this tool bar and its controls, it is possible to perform all tasks associated with usage of the designed and developed tool. Figure 4 represents a schema explaining functions of each control located on the tool bar.
- In addition to the related controls and elements – objects provided on tool interfaces, the scenario – story flow and associated scenes are also important aspects of the learning process ensured within the designed and developed tool. As general, the story of the tool is based on "the idea of enabling the main character to search, find and solve secrets of the computer programming approach". The story begins in the study room of the main character and the "scenario – story flow" begins after the character wants to know essentials of the computer programming while he / she studies on homework. On the main screen of the tool, students are allowed to choose gender of the character, determine a name for him / her in order to use it along the story and adjust some features like hair color, skin color…etc. After determining a character, the following scenes are viewed in order to make the student active within the virtual environment for performing a virtual scenario – story flow.
- Generally, actions performed by the character can also be examined under some titles. At this point, general character moves for searching something or passing through scenes and interacting with virtual elements – objects can be examined under the "general actions" category. On the other hand, character actions for performing exercises or solving the related quizzes

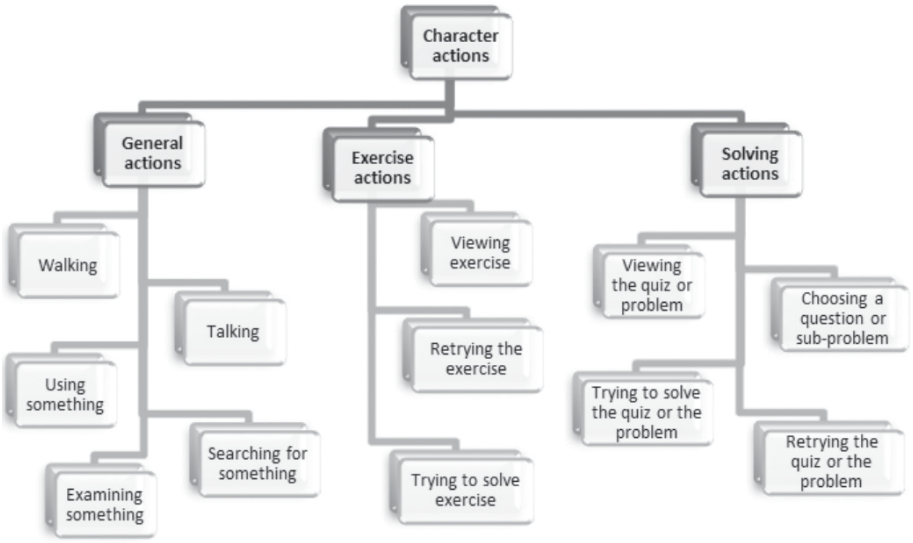


**Figure 5.**
*Character Action within the Course Tool*

or problems can also be examined under "exercise actions" and "solving actions" respectively. Additionally, the character can also perform more specific actions that can be examined in one of the mentioned action titles. The related action titles and the related sub-actions that can be expressed under them are shown briefly under the figure 5.

- As it was mentioned before, students are often directed via some virtual, dynamic messages viewed on the related scenes. In this sense, students can perform any of the shown actions in figure 5. At this point, the conditions (provided interactive, virtual elements – objects, problems…etc.) of a specific scene are also expressed on the related course tool interfaces by using the virtual, interactive messaging function. Figure 6 represents a screenshot from an early scene of the story. As it can be seen from the screenshot, the student is informed about clicking on provided elements – objects within the environment and meanwhile the character

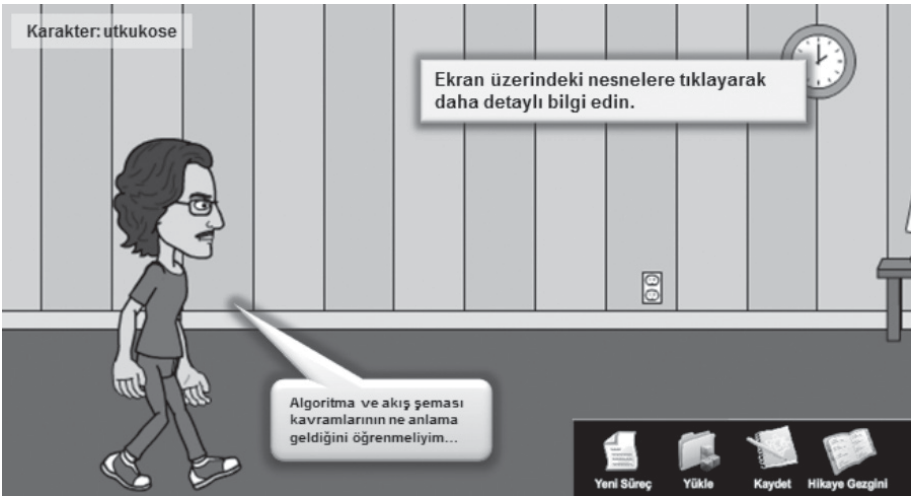


**Figure 6.**
*A Screenshot from an Early Scene of the Story*

is talking about his need for learning the algorithm and the flow chart concepts within the related computer programming course.

Performing exercises within the course tool is also an important action that can be done via provided virtual, interactive elements – objects on the related scenes. The feedback factor is often employed during the exercise sessions that can be encountered while flowing through the related scenario – story. At this point, it is remarkable that a total of "120 exercises" about the course sub-subjects are provided on the related scenes. These exercises are located on critical points of the scenario – flow and students are also enabled to accept or decline taking exercises. However, if a student decline taking an exercise, the related exercise is automatically stored by the software system and student is often warned about taking remaining – declined exercises within the next scenes. A typical exercise is viewed on a specially designed interface independent from scenes and the character is enabled to perform the exercise by using the control approaches like "typing", "dragging-and-dropping", "clicking on – choosing"…etc. During exercises, students are informed about correct or incorrect answers via feedbacks and also directed for finding or searching for actual or alternative solutions. Figure 7 shows a screenshot from an exercise session. In this screenshot, the student has given correct answer to an exercise question and received the related feedbacks and information in this context.

In addition to the exercise sessions, it is also possible to take part in quiz or problem sessions within the related virtual environment. As being different from the exercises, quiz and problem sessions include more difficult questions and also need more interaction between the student and the computer – virtual environment. It is also important that the infrastructure of the quiz and problem sessions are based on an intelligent program that can called as some kind of "knowledge-based system". Programmatic structure of this program is based on an "intelligent tutoring tool", which was previously designed and developed and introduced in the context of another scientific study performed by Kose and Deperlioglu (2012). As different from the related study, the intelligent program included within the course tool employs fewer questions or problems and provide more colorful and specific elements – objects associated with the "story of the course tool".

As being similar to the exercise sessions, it is possible to use several controlling approaches according to the viewed feedbacks and any other messages on the quiz or problem interface. At this point, correct answers are also taken into consideration and the character is rewarded with a point changing from 0 to 100. It is also important that quiz sessions include a total of 5 questions (classical or test questions) whereas problem sessions come with a specific problem that has some several sub-problems that must be solved to obtain a general solution for the problem. But both quiz questions and problems use similar interfaces to enable students to take active part in the related

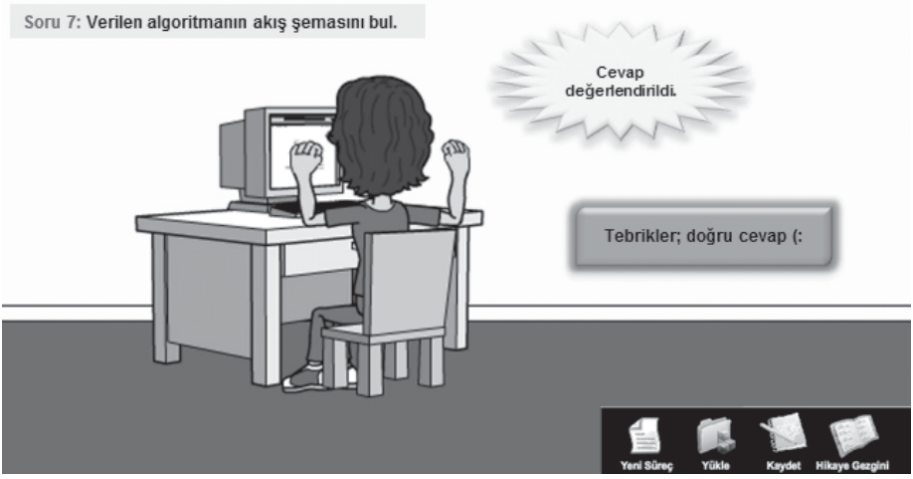


**Figure 7.**
*A Screenshot from an Exercise Session*

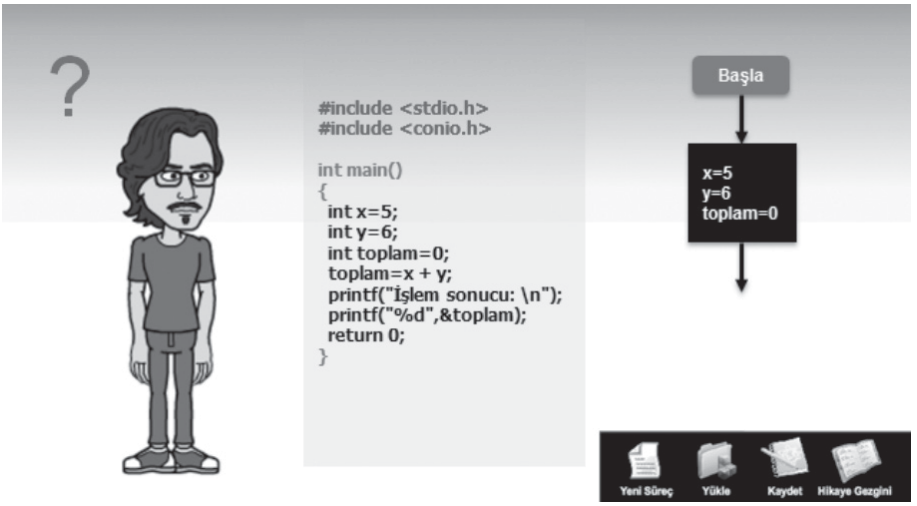


**Figure 8.**
*A Screenshot from a Problem Session*

sessions. Figure 8 shows a screenshot from an active problem session. The related screenshot is about a specific sub-problem based on forming the flow chart of the viewed C programming codes.

All of the explained design principles, pedagogical aspects and using features and functions of the tool points a story-based e-learning tool that can be used effectively and efficiently for learning – teaching computer programming approach and its related sub-subjects. However, all of these explained subjects must be proved via some scientific approaches. In this sense, the next section is devoted to the "application – evaluation processes and findings".

### Application – Evaluation Processes and Findings

In order to test effectiveness of the course tool, an experimental application process has been performed at Usak University in Turkey. In the context of the application process, students from computer-based programs of the Usak University have taken active part within the related groups chosen for a typical experimental approach. In this sense, some remarkable points about the experimental application process can be expressed as follows:

### Design of the Experimental Application Groups

For the experimental application process, 50 students formed the experimental group whereas the control group was formed by another group of 50 students. Thus, a total of 100 students have taken part within the experimental application process. These students have chosen from the Computer Programing program given at the Usak Vocational School of the Usak University. Table 2 shows a brief demographic structure of the experimental application groups.

### Learning Activities along the Process

During the process, the experimental group used the story-based e-learning tool with its all using features and functions in the related learning activities. On the other hand, the control group took the traditional sessions formed by theoretical and applied teaching approaches provided

**Table 2.**
*A Brief Demographic Structure of the Experimental Application Groups*

| Group | Number of students | | Age Distribution | | | Program / Academic Unit |
|---|---|---|---|---|---|---|
| Experimental | 50 | **Male:** 37 | **17-20** | **20-23** | **23-26** | Computer Programming / Usak Vocational School |
| | | **Female:** 13 | 35 | 13 | 2 | |
| Control | 50 | **Male:** 29 | **17-20** | **20-23** | **23-26** | Computer Programming / Usak Vocational School |
| | | **Female:** 21 | 27 | 23 | 0 | |

**Table 3.**
*The General Session-Subjects Structure of the Computer Programming Essentials Course*

| Session / Week | Subject(s) |
|---|---|
| 1st | Computer concept;<br>Software and hardware concepts;<br>Computer programming concept;<br>Basics of the computer programming approach; |
| 2nd | Algorithmic thinking approach;<br>Algorithm and flow chart concepts;<br>Basics of the algorithm and the flow chart concepts - 1; (supported with exercises); |
| 3rd | Basics of the algorithm and the flow chart concepts - 2; (supported with exercises); |
| 4th | Basics of the algorithm and the flow chart concepts - 3; (supported with exercises); |
| 5th | General problems and exercises on algorithms and flow charts; |
| 6th | Basics of the c programming language |
| 7th | Basic operations with c programming language; (supported with exercises); |
| 8th | Operations on 'conditional problems' and 'loops' - 1; (supported with exercises); |
| 9th | Operations on 'conditional problems' and 'loops' - 2; (supported with exercises); |
| 10th | Functions in c programming language - 1; (supported with exercises); |
| 11th | Functions in c programming language - 2; (supported with exercises); |
| 12th | Special structures in c programming language; (supported with exercises); |
| 13th | Exercises and applications with c programming language - 1; |
| 14th | Exercises and applications with c programming language - 2; |

by the teacher (sessions related to c programming language has been performed via compiler on computer). The whole process has continued along a term in which "Computer Programming Essentials" course is given to improve students' knowledge and ability levels about the computer programming approach and the related C programming language. At this point, it is important that the general session-subjects structure of the related course is appropriate with the scenario – story flow of the course tool. In other words, the scenario – story flow of the course tool has been designed as synchronized with the session-subjects structure Computer Programming Essentials course. In order to give more information about the process, the related structure of the Computer Programming Essentials course is given as below:

As it can be seen from the Table 3, the Computer Programming Essentials course begins with explaining the basics of the computer system and enable students to have ideas about essential subjects like computer, software, hardware and computer programming concepts. In this sense, basics of the computer programming approach are also explained in order to enable students to have enough preliminary knowledge about the main course subject. After these processes, the course continues with explaining algorithmic thinking approach and also giving information about algorithm and flow chart concepts. Following to these subjects and performing exercises in the context of the related subjects, the C programming language is explained with its all details. In this sense, the course continues with providing both theoretical and applied information to students and enabling students to have enough knowledge and ability on fundamentals of the computer programming concept – approach and the C programming language.

**Table 4.**
*Obtained Results after the Experimental Application Process*

| Group | Number of students | Students passed the course (%) | Mean | Median | Standard Deviation |
|---|---|---|---|---|---|
| Experimental | 50 | 78 | 75,80 | 80,40 | 18,15 |
| Control | 50 | 46 | 51,43 | 56,25 | 14,25 |

**Results of the Experimental Application Process**

At the end of the Computer Programming Essentials course – term, students' grades were taken into consideration for the experimental evaluation approach. In this sense, table 4 shows the obtained results for both experimental and control groups.

As it can be understood from the table 4, the percentage value of the students passed the Computer Programming Essentials course is significantly high for the experimental group. Furthermore, the mean student grade value of the experimental group is also resulted as higher than the one for the control group. Eventually, results of the experimental application process point improvements in student achievements after using the designed and developed story-based e-learning tool.

In addition to the obtained results, a statistical analysis operation has also been performed in order to understand "if the obtained results between the control and the experimental group grades were similar or not". In this context, the "indepen-

dent samples t-test" was performed and according to the obtained results; it is suggested that the alternative hypothesis: H1 (stating that the means of the two samples are different) cannot be rejected (with 95% confidence).

**Important Points within the Experimental Application Process**

In order to discuss more clearly about the obtained experimental application results, it is also important to think about some points that has been noticed by authors during the process. In this sense, these points may also show some causes of better results obtained with the experimental group. The related important points are expressed as follows:

- As it was explained before, story-based e-learning approach can easily enable students to learn abstract and complex subjects within technical and applied courses via virtual, interactive environments and also objects. So, students in the experimental group enjoyed the self-learning process done with the related course tool and also performed more course activities than the students in the control group.
- The experimental group was faster in the related learning processes, thanks to the provided story-based e-learning tool.
- By using the computer – software technology rather than employing traditional approaches (although the sessions about c programming language have been performed via compiler on computer), students in the experimental group were encouraged more about taking active parts within the learning process.
- The Computer Programming Essentials course is a technical and applied course that needs more practical activities to learn better about the provided subject scope. So, it is important to enable students to perform more practical activities. In this sense, the provided story-based e-learning tool allowed experimental group students to perform more applied activities via computer – software technology. Students in the control group also performed applied activities via traditional approaches (including the usage of compilers on computer), but interactivity, speed and more facilities provided virtually by the tool took the experimental group "one-step-away".
- In addition to the expressed points, it is also possible to express that each student's personal features and any other distinguishing features (age, gender, some specific abilities...etc.) may also affect the results of the experimental application process. But at this point, it was tried to form equivalent groups to get more accurate results.

**Student Survey**

A survey work was also conducted at the end of the related course to find out to what extent the students were accepting the provided story-based e-learning tool. For this aim, a list of 10 statements forming the whole student survey was prepared. Next, the students within the experimental group were asked to express their opinion on the "Likert Scale", checking "1" if they strongly disagree, "2" if they disagree, "3" if they have no clear opinion, "4" if they agree and "5" if they strongly agree with the statement given and the survey work was also performed as anonymous. Table 5 shows the obtained responses for the related survey statements.

**Table 5.**

*Obtained Responses for the Student Survey Work*

| Statement | Number of responses for; | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| "Computer programming can be learned better by using this tool." | 0 | 1 | 2 | 7 | 40 |
| "My achievement level at the course has been improved, thanks to this tool." | 0 | 0 | 3 | 8 | 39 |
| "The tool provides an attractive and effective electronic learning environment." | 0 | 0 | 2 | 11 | 37 |
| "I do not want to take part in a similar course process." | 42 | 5 | 2 | 1 | 0 |
| "During the teacher's lecture processes, this tool has enabled me to understood computer programming concepts better." | 0 | 0 | 5 | 9 | 36 |
| "I have liked the computer programming – exercises provided within the tool." | 0 | 1 | 6 | 11 | 32 |
| "I can learn computer programming faster by using this tool." | 0 | 2 | 3 | 16 | 29 |
| "I have enjoyed the course process performed with the support of this tool." | 0 | 0 | 1 | 6 | 43 |
| "This tool can be adapted to different technical, complex courses." | 0 | 1 | 2 | 10 | 37 |
| "It is too difficult for me to use this tool for learning computer programming." | 35 | 10 | 3 | 2 | 0 |
| | | | | | **Total Respondents:** 50 |

The obtained responses show that the students think positively about usage of the story-based

e-learning tool for learning computer programming approach and the related sub-subjects. In more detail, many positive responses have received about the effectiveness of the tool and its associated fast, efficient using approaches. At this point, the students have also enjoyed the experimental application process performed with the support of the tool. Furthermore, students also think that the tool can be adapted to different technical, complex courses. Eventually, all of the received responses point a positive ideas and trends on the designed and developed story-based e-learning tool.

Related to the obtained responses, more descriptive statistics are also represented in table 6:

**Table 6.**
*More Descriptive Statistics for the Obtained Responses*

| Statement | Min. | Max. | Mean | Std. Dev. |
|---|---|---|---|---|
| "Computer programming can be learned better by using this tool." | 2 | 5 | 4,72 | 0,64 |
| "My achievement level at the course has been improved, thanks to this tool." | 3 | 5 | 4,72 | 0,57 |
| "The tool provides an attractive and effective electronic learning environment." | 3 | 5 | 4,70 | 0,54 |
| "I do not want to take part in a similar course process." | 1 | 4 | 1,24 | 0,63 |
| "During the teacher's lecture processes, this tool has enabled me to understood computer programming concepts better." | 3 | 5 | 4,62 | 0,67 |
| "I have liked the computer programming – exercises provided within the tool." | 2 | 5 | 4,48 | 0,79 |
| "I can learn computer programming faster by using this tool." | 2 | 5 | 4,44 | 0,79 |
| "I have enjoyed the course process performed with the support of this tool." | 3 | 5 | 4,84 | 0,42 |
| "This tool can be adapted to different technical, complex courses." | 2 | 5 | 4,66 | 0,66 |
| "It is too difficult for me to use this tool for learning computer programming." | 1 | 4 | 1,44 | 0,79 |

### Student Comments about the Tool

The related experimental group students, who also took part in the student survey work, were next asked to write down their ideas and suggestions about the related story-based e-learning tool. The most remarkable and interesting comments are listed as below:

"The tool should be adapted to other computer programming oriented courses."

"It was the most entertaining educational material I have ever seen."

"It would be great if this tool could be used for other courses given at my program."

"It would be great if I could use the tool online collaboratively with my friends."

"I want to adjust more visual features of the tool according to my choice."

"I want to add my own computer programming problems to the tool."

"I believe that I can learn complex subjects better if I can use such a tool on my own."

"I want to learn Web based programming via adapted version of this tool."

"For the first time, I have seen colorful and entertaining ways of learning."

As it can be understood from the findings and the related explanations regarding to the findings, the designed and developed story-based e-learning tool has positive effects on students in the context of learning processes of computer programming concept – course.

## Conclusions and Future Work

This paper has introduced a story-based e-learning tool, which provides an alternative approach for teaching – learning computer programming concept and its related sub-subjects; by using a computer supported, interactive environment. In this sense, the related tool is aimed to include advantages of both story-based learning and e-learning approaches in order to ensure effective and efficient teaching – learning processes regarding to the computer programming concept. In this sense, this study is generally dedicated to an introduction of the tool and explanations on objectives in the context of the related educational problems, foundations and the method – solution approach, which has been provided via the related tool. Furthermore; in order to test – evaluate the tool in the sense of achieving the expressed objectives, application – evaluation processes performed in the sense of the study and the related findings obtained via these processes have also been explained in detail, in order to enable readers to have idea about the performed research study and its results.

Findings obtained via application – evaluation processes have provided positive responses in the context of method – solution approach for the related problems of teaching – learning computer programming concept. The story-based e-learning tool, which was designed and developed within this study, provides an effective and efficient

way to learn – teach the computer programming approach and its related sub-subjects. In this sense, the tool ensures an interactive, virtual environment to achieve the related educational objectives via additional, visually and auditory improved elements – objects. At this point, the tool provides an effective solution approach on the problem of learning computer programming approach and enables students to easily learn the related abstract and complex aspects that need more technical and applied methods.

The performed application – evaluation works also show that the tool can successfully support and direct students for learning computer programming approach and it also provide an encouraging way to improve learning – teaching experiences via story-based e-learning approaches. In this context, the educational aspects of the computer – software technology has also an important role on designing and developing such an effective educational material. As general, this study is a successful work on showing the usage of computer – software technology to develop more effective tools for improving understanding and learning levels for especially technical and applied courses including abstract and complex subjects. On the other hand, more specifically; the tool introduced in this study also ensures an effective approach to learn – teach fundamentals of the computer programming approach, which is an essential subject for especially computer and information technologies oriented academic fields.

Positive feedbacks and the related comments and ideas about the tool have also encouraged the authors to develop newer versions of the related tool in order to achieve more quality and successful results in the context of the research subject. In this sense, there are some future works that are planned to be done in the future versions of the tool. Briefly; it is planned to integrate some management modules allowing teachers to organize their own scenario – story flows. Next, the tool will also be adapted to some technical, complex courses that are given at different programs of universities. Finally, future versions of the tool will also support mobile devices and also associated mobile operating systems.

## References


Acelajado, M. J. (2003). *The impact of using technology on students achievement, attitude, and anxiety in Mathematics*. University Research Coordination Office, De La Salle University, Manila, Philippines.

Alario-Hoyos, C., Bote-Lorenzo, M. L., Gómez-Sánchez, E., Asensio-Pérez, J. I., Vega-Gorgojo, G., & Ruiz-Calleja, A. (2013). Enhancing learning environments by integrating external applications. *Bulletin of the IEEE Technical Committee on Learning Technology*, *15* (1), 21-24.

Buckley, B. C., & Quellmalz, E. S. (2013). Supporting and assessing complex biology learning with computer-based simulations and representations. In D. F. Treagust, & C.-Y. Tsui (Eds.), *Multiple representations in biological education* (pp. 247-267). Berlin: Springer.

Caballe, S., Dunwell, I., Pierri, A., Zurolo, F., Ganan, D., Daradoumis, T. et al. (2013). Towards collaborative complex learning objects by the virtualization of collaborative sessions. In M. Y. Lytras, D. Ruan, R. D. Tennyson, P. O. De Pablos, F. J. G. Penalvo, & L. Rusu (Eds.), *Information systems, e-learning, and knowledge management research* (pp. 344-350). Berlin: Springer.

Clark, K., & Dwyer, F. M. (1998). Effects of different types of computer-assisted feedback strategies on achievement and response confidence. *International Journal of Instructional Media*, *25*, 55-63.

Connolly, C., Murphy, E., & Moore, S. (2009). Programming anxiety amongst computing students-a key in the retention debate? *IEEE Transactions on Education*, *52*, 52-56.

Dempsey, J. V., Driscoll, M. P., & Swindell, L. K. (1993). Text-based feedback. In J. V. Dempsey, & G. C. Sales (Eds.), *Interactive instruction and feedback* (pp. 21-54). New Jersey: Educational Technology Publications.

Foote, C. (1999). Attribution feedback in the elementary classroom. *Journal of Research in Childhood Education*, *13*, 155-166.

Garrison, D. R. (2011). *E-learning in the 21st century: A framework for research and practice*. New York, USA: Taylor & Francis.

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, *7*, 95-105.

Georgios, K., Denise-Penelope N. K., Angelos, R., & Stefanos, G. (2007). A PKI approach for deploying modern secure distributed e-learning and m-learning environments. *Computers & Education*, *48* (1), 1-16.

Gilbert, L., Wang, C., & Sim, Y.-W. (2005). An e-learning systems engineering methodology. *Proceedings of the IEEE International Conference on Advanced Learning Technologies (ICALT 2005)*, 150-154.

Gjedde, L. (2006). Story-based e-learning as a vehicle for inclusive education. In A. Méndez-Vilas, A. Solano Martín, J. Mesa González, & J. A. Mesa González (Eds.), *Current developments in technology-assisted education* (pp. 1126-1130). Madrid: Formatex.

Joseph, J. (2012). *Impact of story based learning.* Retrieved October 01, 2012, from http://www.elearningserv.com/blog/impact-of-story-based-learning

Kadle, A. (2010). *Story-based learning.* Retrieved October 01, 2012, from http://www.upsidelearning.com/blog/index.php/2010/08/03/story-based-learning/

Kose, U., & Deperlioglu, Ö. (2012). Intelligent learning environments within blended learning for ensuring effective c programming course. *International Journal of Artificial Intelligence and Applications*, *3* (1), 105-124.

Lau, R. W. H., Yen, N. Y., Li, F., & Wah, B. (2013). Recent development in multimedia e-learning technologies [online]. *World Wide Web* (doi: 10.1007/s11280-013-0206-8).

Lee, S. Y., Mott, B. W., & Lester, J. C. (2010). Optimizing story-based learning: An investigation of student narrative profiles. In V. Aleven, J. Kay, & J. Mostow (Eds.), *Intelligent tutoring systems* (pp. 155-165). Berlin: Springer.

Lin, S.-P., Ho, T.-M., & Hsieh, C.-Y. (2013). Innovative improvement method for e-learning quality: A case of government organizations. *Proceedings of the International Conference on Information, Business and Education Technology (ICIBIT 2013)*, 1131-1134.

McCormack, C., & Jones, D. (1997). *Building a web-based education system*. New York, USA: Wiley.

Ovalle, D. A., Arias, F. J., & Moreno, J. (2013). Student-centered multi-agent model for adaptive virtual course development and learning object selection. In D. G. Sampson, P. Isaias, D. Ifenthaler, & J. M. Spector (Eds.), *Ubiquitous and mobile learning in the digital age* (pp. 51-63). Berlin: Springer.

Pulman, A., Scammell, J., & Martin, M. (2009). Enabling interprofessional education: The role of technol-ogy to enhance learning. *Nurse Education Today*, *29* (2), 232-239.

Robson, R. (2013). The changing nature of e-learning content. In R. H. Kinshuk, & J. M. Spector (Eds.), *Reshaping learning: Frontiers of learning technology in a global context* (pp. 177-196). Berlin Heidelberg: Springer-Verlag.

Sales, G. C. (1993). Adapted and adaptive feedback in technology-based instruction. In J. V. Dempsey, & G. C. Sales (Eds.), *Interactive instruction and feedback* (pp. 159-176). New Jersey: Educational Technology Publications.

Toral, S. L., Barrero, F., Martínez-Torres, M. R., & Gallardo, S. (2007). Interactive multimedia teaching of digital signal processors. *Computer Applications in Engineering Education*, *15* (1), 88-98.

Wisdom Tools. (2009). *Story-based learning*. Retrieved October 02, 2012, from http://wisdomtools.net/inner.asp?id=398&category=6.